Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Stability of Inviscid Flow over Airfoils Admitting Multiple Numerical Solutions YA LIU[1], JUNTAO XIONG[2], FENG LIU[3], SHIJUN LUO[4], University of California, Irvine — Multiple numerical solutions at the same flight condition are found of inviscid transonic flow over certain airfoils (Jameson et al., AIAA 2011-3509) within some Mach number range. Both symmetric and asymmetric solutions exist for a symmetric airfoil at zero angle of attack. Global linear stability analysis of the multiple solutions is conducted. Linear perturbation equations of the Euler equations around a steady-state solution are formed and discretized numerically. An eigenvalue problem is then constructed using the modal analysis approach. Only a small portion of the eigen spectrum is needed and thus can be found efficiently by using Arnoldi's algorithm. The least stable or unstable mode corresponds to the eigenvalue with the largest real part. Analysis of the NACA 0012 airfoil indicates stability of symmetric solutions of the Euler equations at conditions where buffet is found from unsteady Navier-Stokes equations. Euler solutions of the same airfoil but modified to include the displacement thickness of the boundary layer computed from the Navier-Stokes equations, however, exhibit instability based on the present linear stability analysis.

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Date submitted: 02 Aug 2012 Electronic form version 1.4